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QUENCH PLATEAU, COIL CURE TEMPERATURE, AND COPPER-TO SUPERCONDUCTOR RATIO IN RECENT 1.8 m SSC MODEL DIPOLES*

P. Wanderer

Accelerator Development Department
Magnet Division
Brookhaven National Laboratory
Upton, New York 11973

SUMMARY

The ratio of the conductor-limited quench currents to the short-sample prediction, I_Q/I_{ss} , is tabulated for a series of 1.8 m-long SSC model collider dipoles. Sixteen of these magnets have 40 mm aperture, four have 50 mm aperture. For these magnets, the coil cure temperature ranged from 135 C to 217 C and the ratio of copper-to-superconductor ranged from 1.27 to 1.54. At 4.35 K, the value of I_Q/I_{ss} was between 1.00 and 1.04 with no clear dependence on cure temperature or Cu:S.C. ratio.

This note collects data from recent short SSC R&D dipoles made at BNL. All the magnets reached a stable quench plateau at a nominal temperature of 4.35 K, as summarized in Table I. In all the magnets, these conductor limited quenches occurred in the pole turn of the inner coil, as expected. The magnet plateau current is compared to the expected value I_{ss} , which has been calculated from the 7 T value of the critical current I_c using G. Morgan's parameterization (AUTOIC90).

The Table also lists two construction features: the copper-to-superconductor ratio of the cable used in the inner coil and the cure temperature of the coils during molding. The cure temperatures are dictated by the choice of cable insulation. For the DSS magnets and DSA207, 208 in the Table, the standard epoxy-fiberglass-Kapton scheme was used. For the DS020n magnets, different combinations of all-Kapton insulation were used. The polyimide adhesive used in DS0201-DS0204 required a higher cure temperature than the epoxy used in DS0205, 206. DSA209, 210 also had polyimide adhesive.

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Generally speaking, the uncertainties in the ratio I_Q/I_{ss} are estimated to be at the level of 2%. This includes uncertainties in both I_c (7 T) and I_Q and possible vendor-to-vendor differences (e.g., IGC SI-64 vs. OST SC14-2).¹ Within this uncertainty, the plateau current as a fraction of short sample does not appear to be affected by the different cure cycles or copper-to-superconductor used in these magnets.

Table I. Quench Plateau and Construction Data for
1.8 m long, 40 mm and 50 mm Aperture SSC Dipoles

40 mm Aperture Magnets	Nominal Coil Cure Temp. (C)	Cable for Inner Coils	Cu:SC Ratio	I_c (7 T) (A)	I_{ss} (A) (4.35 K)	I_Q (A)	I_Q/I_{ss}
DSS013	135	IGC SI-64	1.47	7741	6784	6950	1.024
DSS014	135	IGC SI-64	1.47	7741	6784	6855	1.010
DSS016	135	IGC SI-64	1.47	7741	6784	6950	1.024
DSS017	135	IGC SI-64	1.47	7741	6784	6925	1.020
DSS018	135	OST SC14-2	1.53	7020	6577	6790	1.032
DSS019	135	OST SC14-2	1.53	7020	6577	6770	1.029
DSS020	135	OST SC14-2	1.53	7020	6577	6810	1.035
DSS021	135	OST SC14-2	1.53	7020	6577	6820	1.037
DS0201	217	IGC SC13-3	1.53	7851	6803	6875	1.009
DS0202	217	IGC SC13-3	1.53	7851	6803	6865	1.007
DS0203	217	IGC SC13-3	1.53	7851	6803	6895	1.012
DS0204	217	OST (SSC-I-0-11)	1.27	8603	6997	7060	1.009
DS0205	170	OST (SSC-I-0-11)	1.27	8603	6997	7040	1.006
DS0206	170	OST (SSC-I-0-11)	1.27	8603	6997	7060	1.009
DS0213	217	OST (SSC-I-0-11)	1.27	8603	6997	7015	1.003
DS0214	217	OST (SSC-I-0-11)	1.27	8603	6997	7036	1.006
50 mm Aperture Magnets	Nominal Coil Cure Temp. (C)	Cable for Inner Coils	Cu:SC Ratio	I_c (7 T) (A)	I_{ss} (A) (4.35 K)	I_Q (A)	I_Q/I_{ss}
DSA207	135	SSC-3-I-22	1.54	10827	7440	7500	1.008
DSA208	135	SSC-3-I-22	1.54	10827	7440	7600	1.022
DSA209	217	SSC-3-S-22	1.51	10079	7315	7390	1.010
DSA210	217	SSC-3-S-22	1.51	10079	7315	7405	1.012

¹For cable SC13-3, I_{ss} is the average of measurements made on four different segments covering 80% of the cable length which have an rms variation of 20 A. I_c data from one end of the cable were about 1-1/2% lower and were not used in the average. The magnets reported here used cable from the opposite end of the spool. For DS0203, I_{ss} is for the coil half in which the plateau quenches occurred.

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